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SPECIFICATION FOR CONDUCTORS AND EARTH WIRE ACCESSORIES FOR OVERHEAD POWER LINES

PART II MID-SPAN JOINTS AND REPAIR SLEEVES FOR CONDUCTORS

(First Revision)

Third Reprint NOVEMBER 1994

UDC 621.315.65:621.315.171

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 3 *August* 1981

Indian Standard

SPECIFICATION FOR CONDUCTORS AND EARTH WIRE ACCESSORIES FOR OVERHEAD POWER LINES

PART II MID-SPAN JOINTS AND REPAIR SLEEVES FOR CONDUCTORS

(*First Revision*)

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SPECIFICATION FOR CONDUCTORS AND EARTH WIRE ACCESSORIES FOR OVERHEAD POWER LINES

PART II MID-SPAN JOINTS AND REPAIR SLEEVES FOR CONDUCTORS

(First Revision)

0. FOREWORD

0.1 This Indian Standard (Part II) (First Revision) was adopted by the Indian Standards Institution on 21 April 1981, after the draft finalized by the Conductors and Accessories for Overhead Lines Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 The use of ACSR and all aluminium conductors for power transmission is now well established. As a natural consequence, special types of fittings are required to be used for such power lines. This standard has been prepared with a view to ensuring uniform requirements of the various types of such fittings and providing necessary guidance to the manufacturers and the buyers.

0.3 Of the fittings that are used in overhead power lines, anchor clamps and suspension clamps are two which could be considered either as conductor fittings or insulator fittings. Indian Standard specification on insulator fittings has been published separately. To avoid duplication, these two types of fittings have been included in the Indian Standard on insulator fittings.

0.4 This standard was first published in 1962. This revision has been undertaken to upgrade many of essential performance requirements for the fittings used on overhead power lines.

In the revised standard various types of fittings used on overhead lines have been covered in the following three parts:

Part I	Armour rods, binding wires and tapes for conductors;
Part II	Mid-span joints and repair sleeves for conductors; and
Part III	Accessories for earth wire.

0.5 If agreed between the purchaser and the supplier the conductor and earth wire accessories may also be made suitable for application of hot line techniques.

0.6 In the preparation of this standard assistance has been derived from B S 3288 : Part I : 1973 'Specification for insulator and conductor fittings for overhead power line : Part I Performance and general requirements', issued by British Standards Institution.

0.7 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard (Part II) covers the joints normally used for joining and repairing ACSR, all aluminium or aluminium alloy overhead conductors. The following types of joints are covered by this standard:

a) Compression type mid-span joints,
b) Twisting sleeves and repair sleeves,
c) Compression type of repair sleeves, and
d) Crimped joints.

2. TERMINOLOGY

2.1 The definitions given in Part I of this standard shall apply.

3. MATERIAL

3.1 A compression type mid-span joint consists of the following parts:

a) An aluminium tube produced from 99·5 percent pure aluminium by extrusion process for AAC and ACSR conductors,
b) Aluminium alloy tube for aluminium alloy conductors,
c) A steel tube produced from steel rod and hot dip galvanized for steel core of ACSR conductors, and
d) Tapered plugs, machined from aluminium rod of 99 percent purity.

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*Rules for rounding off numerical values (*revised*).

3.2 Twisting joint sleeves shall be manufactured from high quality aluminium alloy.

3.3 Repair sleeves shall be manufactured from 99·5 percent pure aluminium by extrusion process.

3.4 The crimping sleeves for ACSR conductors requires the use of special aluminium alloy to obtain the required strength and other properties.

4. CONSTRUCTION AND GENERAL REQUIREMENTS

4.1 The dimensional details of the aluminium and steel tubes shall be in accordance with Table 1. The sizes of the aluminium and steel tubes vary with the conductor size and their construction. While the outside diameter of the tubes has been designed to cover a range of conductor sizes, the inside diameter shall be made to suit the specific size. Table 1 gives the outside diameters of the tubes covering range of diameters.

4.2 ACSR conductor require steel tube to join steel core and aluminium tube to join the aluminium strands. In case of all aluminium and aluminium alloy conductors, the steel tubes shall not be used.

4.3 The aluminium tube and steel tube when compressed into hexagonal shape shall have the dimensions (across flats and corner) as given in Table 1.

4.4 The tension joints shall be so designed that they ensure satisfactory and trouble free life of the conductor. They shall be designed, manufactured and finished so as to avoid sharp radii of curvature, ridges and excrescences which might lead to localized pressure on or damage to the conductor in service. The fitting shall have sufficient contact surface to minimize damage due to fault currents.

4.5 The size of the crimping sleeves and number of crimps required for a particular size of conductor shall be agreed upon between the purchaser and the supplier.

4.6 Repair sleeves shall be designed to make good a conductor of which not more than one-sixth of the strands in the outermost layer have been severed.

TABLE 1 DIMENSIONAL DETAILS OF ALUMINIUM AND STEEL TUBES

(*Clauses* 4.1 *and* 4.3)

All dimensions in millimetres.

CONDUCTOR DIA RANGE	ALUMINIUM TUBE			STEEL TUBE		
	OD	Dimensions After Compression		OD	Dimensions After Compression	
		Across Flat	Across Corners		Across Flat	Across Corners
(1)	(2)	(3)	(4)	(5)	(6)	(7)
34-28·96	54	46	53	24	20·2	23·4
30·15-25·88	48	40	46	20·8	17·5	20·2
26·7 -23·45	43	36	41	19·2	16·1	18·5
23·54-19·53	38	32	37	18·0	15·1	17·4
18·13-16·52	33	28	32·6	15·2	12·2	14·7
15·86-14·15	30	25	29·4	12·2	10·1	11·7

NOTE 1 — For conductors having intermediate diameters, select the joint of higher size.

NOTE 2 — For conductor sizes, overlapping in the range, select the higher size joint for the higher strength conductor.

5. MARKING

5.1 Fittings may also be marked with the Standard Mark.

5.2 The use of the Standard Mark is governed by the provisions of Bureau of Indian Standards Act, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

6. TESTS

6.1 Classification of Tests

6.1.1 *Type Tests* — The following shall constitute the type tests:

a) Visual examination (*see* **6.2**);
b) Dimensional verification (*see* **6.3**);
c) Failing load test (*see* **6.4**);
d) Electrical resistance test (*see* **6.5**);
e) Heating cycle test (*see* **6.6**);
f) Galvanizing test (*see* **6.7**);
g) Radio interference voltage test (*see* **6.8**); and
h) Corona test (*see* **6.9**).

6.1.2 *Assembly for the Test on Repair Sleeves* — A length of conductor of the size and type with which the sleeves is to be used shall be taken and a number of adjacent strands in the outermost layer shall be severed. The number of severed strands shall be the nearest whole number of one-sixth of total number of strands in the outermost layer. The severed strands shall be marked so that they can easily be identified on both sides of the repair sleeve after it has been fitted up. The repair sleeve shall then be assembled to make good the damaged conductor, in accordance with the manufacturer's recommendations.

6.1.3 *Acceptance Tests* — The following shall constitute the acceptance tests:

a) Visual examination (*see* **6.2**);
b) Dimensional verification (*see* **6.3**);
c) Failing load test (*see* **6.4**); and
d) Galvanizing test (*see* **6.7**).

6.1.3.1 Electrical resistance test (*see* **6.5**) may also be carried out as acceptance test if agreed between the purchaser and the supplier.

6.1.3.2 The sampling procedure and criteria of acceptance shall be subject to agreement between the supplier and the purchaser. In the absence of such an agreement, the sampling procedure detailed in Appendix A may be followed.

6.1.4 *Routine Test* — The following tests shall be carried out on each fittings:

a) Visual examination (*see* **6.2**), and

b) Dimensional verification (*see* **6.3**).

6.2 Visual Examination — All fittings shall be checked visually for good workmanship and smooth finish.

6.3 Dimensional Verification — The dimensions shall be checked as per the approved drawings and the requirements given in **4.1**.

6.4 Failing Load Test — A tensile load of about 50 percent of the breaking load of the conductor shall be applied and the conductor shall be marked in such a way that movement relative to the fitting can easily be detected. Without any subsequent adjustment of the fitting, the load shall be steadily increased to 95 percent of the breaking load and then reduced to 90 percent of the breaking load and maintained for one minute. There shall be no movement of the conductor relative to the fitting during this one minute period and no failure of the fittings. For the purpose of this test the breaking load of the conductor shall be taken as the value given in the appropriate part of IS : 398 (Parts I to IV)*.

NOTE — Test shall be conducted after the compression joint has cooled to ambient temperature.

6.5 Electrical Resistance Test

6.5.1 The measurement for resistance shall be carried out to an accuracy of one part in thousand by means of a suitable method of test.

6.5.2 The test may be made with dc or ac at any convenient power frequency. The electrical connections shall be so made that effective contact is made with all those strands of the conductor which would be taken into account in calculating its equivalent resistance.

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*Aluminium conductors for overhead transmission purposes:
Part I Aluminium stranded conductors (*second revision*).
Part II Aluminium conductors, galvanized steel reinforced (*second revision*).
Part III Aluminium conductors, aluminized steel reinforced (*second revision*).
Part IV Aluminium alloy stranded conductors (*second revision*).

6.5.3 The electrical resistance shall be measured between points on the conductor on either side and just clear of the fitting and shall not exceed 75 percent of the measured resistance of the equivalent length of conductors.

6.6 Heating Cycle Test

6.6.1 This test is applicable in the case of compression type of mid-span joints only. The fitting shall be assembled in accordance with the manufacturer's recommendations on conductor of the size and type with which it is to be used. The assembly shall be erected indoors so that the conductor is roughly horizontal. Air shall be freely circulated around the assembly. No draughts shall be allowed. The minimum length of conductor on each side of the fitting shall be 2 m.

6.6.2 The test current shall be that power frequency current which raises the surface temperature of the conductor 40°C above the ambient temperature and maintains the temperature at a steady value. The minimum length of conductor used for determining this current shall be 2 m and the conductor temperature shall be measured near the centre of the test length.

6.6.3 The test current shall be passed continuously through the assembly for a period of 30 minutes. The current shall then be interrupted and the assembly shall be allowed to cool to within 5°C above the ambient temperature. The sequence of operations shall be repeated so that 250 cycles of heating and cooling are applied. The fitting shall not be tightened or adjusted during the test.

6.6.4 During the last 5 cycles, the temperature, measured when the current is flowing, at any point on the surface of the fitting shall not exceed that of the conductor. At the end of the test, the fitting shall meet the requirements of the resistance test given in **6.5.3**. The fitting shall afterwards be opened and there shall be no sign of local heating, burning or fusing of any part of the fitting or of the conductor.

6.7 Galvanizing Test — Galvanized parts shall be tested in accordance with IS : 2633-1972* for uniformity, and IS : 6745-1972† for weight of zinc coating, and shall meet the requirements of these standards.

6.8 Radio Interference Voltage Test (Applicable in the Case of Transmission Lines at 400 kV and Above) — The test shall be conducted in accordance with IS : 8263-1976‡ simulating the maximum

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*Method of testing uniformity of coating on zinc coated articles (*first revision*).

†Methods for determination of mass of zinc coating on zinc coated iron and steel articles.

‡Method for radio interference tests on high-voltage insulators.

surface voltage gradient as obtained on the line corresponding to 1·1 times the rated phase to ground voltage.

6.9 Corona Test (Applicable in the case of Transmission Lines at 400 kV and Above) — The test specimen shall be installed on a bar with diameter equal to conductor dia ± 0·25 mm arranged in a bundle with subconductor spacing as desired by the purchaser. The sample shall then be subjected to 50 Hz phase to ground voltage simulating the maximum surface gradient as obtained on the line corresponding to 80 percent of the rated line voltage. There shall be no evidence of corona on any part of the test specimen. The corresponding corona inception voltage shall also be recorded.

APPENDIX A

(*Clause* 6.1.3.2)

SAMPLING AND CRITERIA FOR CONFORMITY OF ACCEPTANCE TESTS

A-1. LOT

A-1.1 In a consignment, the conductors fittings of the same type and size manufactured in the same factory under similar conditions of production shall be grouped together to constitute a lot.

A-1.2 The number of fittings to be selected from each lot shall depend upon the size of the lot and shall be in accordance with col 1 and 2 of Table 2.

TABLE 2 SAMPLE SIZE AND ACCEPTANCE NUMBER

(*Clauses* A-1.2 *and* A-2.1)

Lot Size	For Visual and Dimensional Verification		Sample Size for Failing Load and Galvanizing Test
	Sample Size	Acceptance Number	
(1)	(2)	(3)	(4)
Up to 100	8	0	2
101 to 300	13	0	3
301 to 500	20	1	4
501 to 1 000	32	2	5
1 001 and above	50	3	6

A-1.2.1 These fittings shall be selected from the lot at random. In order to ensure the randomness of selection, procedures given in IS : 4905-1968* may be followed.

A-2. NUMBER OF TESTS AND CRITERIA FOR CONFORMITY

A-2.1 All the fittings selected at random from the lot shall be subjected to visual and dimensional verification tests. A fitting failing to satisfy any of these tests shall be considered as defective. The lot shall be considered as conforming to requirements of these tests, if the number of defectives found in the sample is less than or equal to the corresponding acceptance number given in col 3 of Table 2, otherwise the lot shall be rejected.

A-2.2 The lot which has been found as conforming to the above requirements shall be subjected to failing bad test and galvanizing test. For this purpose, the sample size shall be in accordance with col 1 and 4 of Table 2. The lot shall be considered as conforming to these requirements, if no defective is found in the sample.

A-2.3 The lot shall be considered as conforming to the requirements of acceptance tests, if no defective is found in the sample.

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*Methods for random sampling.

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